

**A NEW *ALEIODES* (= *TETRASPHEROPYX*)
(=*A. PILOSUS* GROUP), WITH A HOST RECORD
FROM MISSOURI, U.S.A.,
BIOLOGICAL REMARKS, AND
PREVIOUS TYPE DEPOSITORY CORRECTIONS¹**

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ABSTRACT: *Aleiodes reisi*, a new species of parasitoid wasp with an enlarged, heavily sculptured, carapace-like metasomal tergite IV was reared from the geometrid *Macaraia multilineata* Packard collected from Eastern Red Cedar (*Juniperus virginiana* L) in Missouri. It is described from both female and male specimens. Illustrations are provided of the mummy, the wasp habitus, and a color pattern sexual dimorphism on the first metasomal tergite.

KEY WORDS: Parasitoid, Braconidae, Rogadinae, Geometridae, *Aleiodes reisi*, *Juniperus virginiana*, *Macaraia multilineata*, United States, Missouri

Aleiodes Wesmael is a large group of parasitic wasps, comprising about 300 species worldwide and found on every continent except Antarctica (Chen and He 1997). Like other members of the tribe Rogadini, *Aleiodes* are koinobiont endoparasitoids of lepidopteran larvae that mummify the host larva when it dies and pupate inside the mummy. The mummy is composed of the larval host's skin, which hardens and darkens into a characteristically shaped structure (Fig. 1), often lined inside with an inner silken cocoon (Shaw and Huddleston 1991). Before it pupates, the parasitoid larva usually cuts a hole in the ventral thoracic region of the host mummy, through which the mummy is glued to a substrate (leaf, twig, etc.). The adult *Aleiodes* exit hole is smoothly, roundly cut in the dorso-posterior area of the mummy (Shaw 1997).

The *Aleiodes* (Wesmael) [*Tetrasphaeropyx* (Ashmead)] subgenus shares the above pupation characters with *Aleiodes* (Fortier 2006a, b; Fortier 2008). The group is defined by the carapace-like fourth abdominal tergite that covers all tergites posterior to it, occasionally with the apex of tergite V showing underneath (Fig. 6). *Aleiodes* (*Tetrasphaeropyx*) species are known only from the Nearctic. Records are known from as far south as Oaxaca State, Mexico, north to the Yukon Territory, Canada, and east to Labrador (Fortier 2006b, 2007a, b). *A. (Tetrasphaeropyx)* specimens are infrequently collected (Shaw 1997), and their host associations remained unknown until recently (Fortier 2006a, b; 2007a, b, 2008a). The group attacks only inchworm caterpillars (Geometridae) so far as known.

When specimens of four undescribed *A. pilosus*-group species were included in a morphological phylogenetic analysis of *Aleiodes*, they were recovered as a

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monophyletic group within *Aleiodes* based on the carapace-like, sculptured 4th metasomal tergite (Fortier and Shaw 1999). The monophyly of the subgenus has recently been verified by morphological phylogenetic analyses conducted by author JF (unpublished data). *Aleiodes* (*Tetrasphaeropyx*), including the specimens currently reported, shares the following synapomorphies with other *Aleiodes* species: 1) basal portion of tarsal claw rounded with a pecten of spines (Shaw 1995); 2) tergite II carinate and anteromedial area with a polished triangular region that continues posteriad as a median carina (Shaw 1995); 3) median carina of propodeum not forking before anterior half of the segment and never diverging posteromedially into an areola (Shaw 1995); 4) forewing RS+Mb vein long (Shaw 1995); 5) emergence hole from host mummy even and circular (Shaw 1995); 6) ovipositor sheath widened and flattened (van Achterberg 1991).

The purpose of this paper is to describe a new *A. pilosus*-group species that is also the first record of the group in Missouri U.S.A. Host information is also provided.

METHODS

Species cited in this paper can be identified as belonging to the subfamily Rogadinae by using the keys of Shaw (1995), Shaw and Huddleston (1991), or Wharton et al. (1997). My definition of *Aleiodes* follows that of Fortier and Shaw (1999), Shaw (1995), Shaw et al. (1997), and van Achterberg (1991). Specimens can be identified as *Aleiodes* by using the keys of van Achterberg (1991) or Wharton et al. (1997).

For purposes of comparison, specimens of previously described species borrowed from the following museums were used: The American Entomological Institute (AEI), the Academy of Natural Sciences at Philadelphia (ANSP), the Albert J. Cook Arthropod Research Collection at Michigan State University (ARC), the Canadian National Collection (CNC); the Cornell University Insect Collection (CUIC), the Insect Research Collection at the University of Wisconsin, Madison (IRC), the Snow Entomological Museum (SEMC), the Smithsonian National Museum of Natural History (NMNH), the National Museum of Scotland (NMS), the Rocky Mountain Systemic Entomology Laboratory (RMSEL), the Texas A&M University Entomology Collection (TAMU), the Essig Museum of Entomology at the University of California at Berkeley (EMEC), and the Bohart Museum of Entomology at the University of California at Davis (UCDC).

Observations and measurements were made with a Leica MZ 12.5 stereomicroscope. An ocular micrometer in the eyepiece of the microscope was used for measurements. Images were made with a Syncrosopy Automontage photo-imaging system. Morphological terms follow Sharkey and Wharton (1997). Sclerite surface sculpturing terminology follows Harris (1979). The term 'carapace' refers to the 4th metasomal tergite. The term "longitudinal angle" is defined and illustrated in Figs. A and B.

The paratype (male) specimen (see Fig. 5) of the new species herein described was reared from host material collected in the field. It was obtained as follows. One hundred twenty geometrid caterpillars were collected from red cedar (*Juniperus virginiana* L.) using a beating sheet at Reis Biological Station of Saint Louis University in Crawford County, Missouri, U.S.A. Each caterpillar was photographed and then reared separately with a host plant clipping in a plastic Clear View Sell Out hinged lid 1 compartment tray manufactured by PACT IV Corporation. These caterpillar 'cages' were situated outdoors under a roofed enclosure without walls under conditions of ambient temperature and humidity. They were cleaned weekly, at which times fresh moist paper toweling and *J. virginiana* clippings were added. One of the caterpillars was transformed into a mummy (Fig. 1) from which the paratype male emerged. The holotype female specimen (Figs. 2-4) was collected by sweeping *J. virginiana* about 0.25 mile (0.4 km) from the location where the paratype host had been collected.

The host was identified as follows. The photograph of the paratype host geometrid that was taken at the time of its capture was forwarded to Dr. David Wagner (University of Connecticut, Storrs, Connecticut, U.S.A.) for identification, as well as photographs of four reared adult geometrids whose larval photographs at the time of capture matched that of the paratype host. Images of larvae were taken with a Nikon DS 70 SLR digital camera with one section of an extension tube and a Nikon DX 18-70 zoom lens. Images of the mummy and morphological features were taken with a Leica MZ12.5 stereomicroscope and AutoMontage imaging system. Morphological terms follow Sharkey and Whar-ton (1997). Sclerite surface sculpturing terminology follows Harris (1979).

SYSTEMATIC ENTOMOLOGY

Aleiodes (Tetrasphaeropyx) reisi n. sp.

Female. Body Color: head yellow-orange except black inter-ocellar triangle; antennae black, prothorax yellow-orange; mesoscutum bicolored, yellow-orange except also with black on lateral lobes; scutellum yellow-orange; mesopleuron yellow-orange except venter also with black; metapleuron bicolored with black; propodeum almost entirely black except yellow in postero-lateral corners; metasomal tergite I yellow with a pair of black spots, one on each side of median carina (Fig. 3); tergite II entirely yellow; tergite III black except yellow along basal and lateral edges; tergite IV entirely black; foreleg yellow-orange basally, tibia infumate, tarsus black, middle and hind legs yellow-orange basally, apices of femora black, tibiae and tarsi entirely black; fore- and hind-wings lightly infumate, veins yellow at wing base, otherwise veins and stigma black. **Body Length:** 4.1 mm. Forewing length: 3.1 mm. **Head:** ocelli medium sized, ocellular distance 1.1 length of longest diameter of lateral ocellus; 42 flagello meres, all distinctly longer than wide, all with width: length ratio less than 0.8; malar space short, 0.9 width of mandibular base and 0.35 length of eye height; oral space small, vertically oblong, clypeus medial height 0.9 length of oral space

medial height, oral space horizontal diameter 0.95 width of mandibular base; occipital carina incomplete at vertex; face coriaceous. **Mesosoma:** each side of pronotum transversely bisected by porcate sulcus; pronotum coriaceous-carinate ventro-laterally, coriaceous dorso-laterally; mesoscutum coriaceous, notauli scrobiculate, terminating at lateral edges of posterior-medial rugose area; mesopleuron with a faintly convex, vaguely defined sternular area, mesopleuron coriaceous; propodeum rugose-areolate, median carina complete. **Legs:** tarsal claws without apical pectination, dorsal surfaces of metacoxa coriaceous. **Wings** (Fig. 7): forewing vein r 0.7 length of 3RSa, second submarginal cell trapezoidal, 1CUa 0.36 length of 1CUB; hind wing vein RS slightly sinuate, marginal cell narrowest at middle, 1r-m 0.6 length of 1M, 1M 0.6 length of M+CU, m-cu pigmented, 0.7 length of 1r-m. **Metasoma:** tergites I and II rugocostate, tergites III and IV densely rugulocostulate, tergite IV a dorso-posteriorly curved carapace not entirely covering apical tergites.

Male. As in female except with more extensive black coloration on mesopleuron, scutellum, propodeum, and metasoma (Fig. 4).

Type Data. Holotype. Female: USA: MISSOURI, Crawford County, Reis Biological Station, Sweep of *Juniperus virginianus*, 21 June 2007, J. Fortier, coll. Deposited in NMNH. *Paratype. Male:* USA: MISSOURI, Crawford County, Reis Biological Station, N 37°56.956', W91°10.145', reared from geometrid *Macaraia multilineata* Packard that had been collected from *Juniperus virginianus* (Eastern Red Cedar) on 23 June 2007. Wasp emerged after July 15 and before 15 August 2007. C. Sherman and J. Fortier, colls. Deposited in NMNH.

Distribution. Known only from type locality in southeastern Missouri.

Biology. Reared from geometrid *Macaraia multilineata* collected from *Juniperus virginiana*.

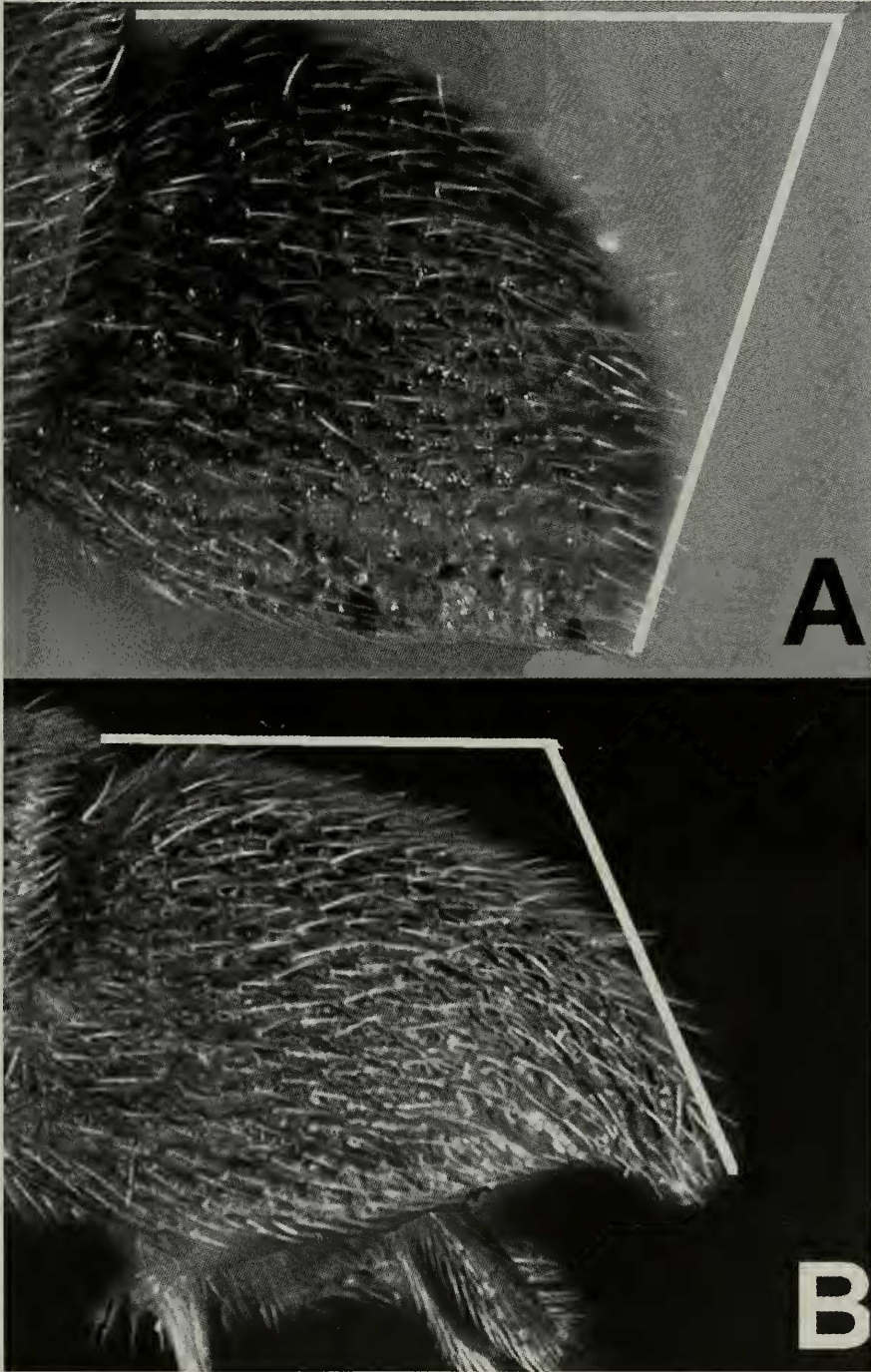
Comments. This species is distinguished from other *Aleiodes* species with an entirely heavily sculptured metasomal tergite IV not entirely covering apical tergites by the following combination of characters: 1) yellow-orange mesosomal coloration and bicolored metasoma in contrast to entirely black; 2) all tibiae, and tarsi of middle and hind legs black, in contrast to yellow-orange, and 3) tergite IV more nearly entirely covering all apical tergites (Figs. 5-6).

Etymology. The specific name is after Raymond Reis, S. J., who taught in the Biology Department at Saint Louis University.

CORRECTIONS

The following are corrections by author JF to previous articles regarding voucher specimen depositions. In *Entomological News* 117(5) 465-484, the following collections are depositories for the following specimens rather than NMNH as stated in that article: *A. areolatus* type and paratype: TAMU; *A. citriscutum* holotype: AEI; 1 *A. citriscutum* paratype: SNOW; 2 *A. citriscutum* paratypes: TAMU; *A. cochisensis* holotype: SNOW; *A. dorsofoveolatus* holotype and

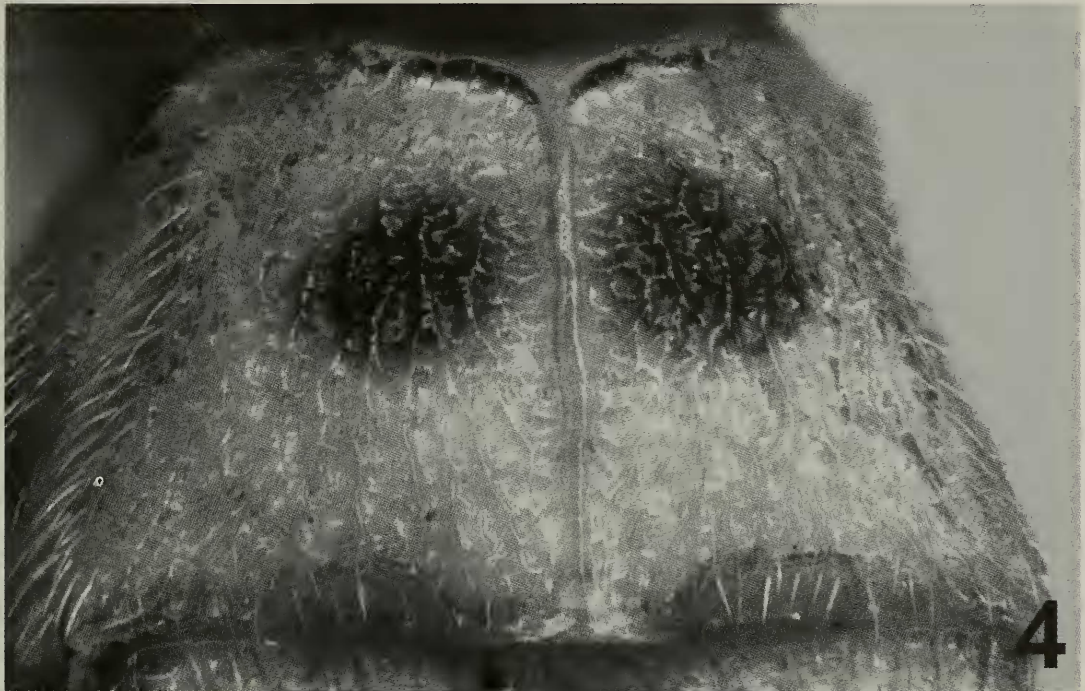
paratype: BOHART; *A. oaxacensis* holotype: TAMU; and *A. tulensis* holotype and 2 paratypes: TAMU. In *Entomological News* 118(1): 11-30, voucher designation should be changed from NMNH to the following collections for the following voucher specimens: *A. jaliscoensis* holotype and 1 paratype: TAMU; *A. quickei* holotype and 4 paratypes: TAMU; and *A. shawi* 2 paratypes: RMSEL.



Figs. A and B. Interior angle of curvature of carapace. The interior angle of curvature is the angle at which a line extending from the apical edge of the 3rd tergite and touching the basal hump of the carapace will intersect a line drawn parallel to the apex of the carapace. A. less than 90° ; B. greater than 90° .



Figs. 1-3. 1. Mummy formed by paratype male of *Aleiodes reisi*. Note exit hole cut by emerging adult at right (dorso-posterior of mummy). 2-3. Holotype female of *Aleiodes reisi*. 2, habitus; 3, wings.



Figs. 4-5. Color pattern sexual dichromatism on metasomal tergite I of *Aleiodes reisi*. 4, holotype female; 5, paratype male.



Fig. 6. Carapace (metasomal tergite IV) of holotype female of *Aleiodes reisi*.

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LITERATURE CITED

Achterberg, K. van. 1991. Revision of the genera of the Afrotropical and W. Palearctic Rogadinae Foerster (Hymenoptera: Braconidae). *Zoologische Verhandelingen* 273: 3-102.

- Chen, X. and J. He.** 1997. Revision of the subfamily Rogadinae (Hymenoptera: Braconidae) from China. *Zoologische Verhandelingen* 308: 1-187.
- Fortier, J. C. and S. R. Shaw.** 1999. Cladistics of the *Aleiodes* lineage of the subfamily Rogadinae (Hymenoptera: Braconidae). *Journal of Hymenoptera Research* 8(2): 204-237.
- Fortier, J. C.** 2006a. The first host association for *Aleiodes pilosus* (= *Tetrasphaeropyx* Ashmead) (Hymenoptera: Braconidae: Rogadinae). *Entomological News* 117(4): 457-459.
- Fortier, J. C.** 2006b. Twelve new species and a new combination of the *Aleiodes pilosus* species-group (= *Tetrasphaeropyx* Ashmead) (Hymenoptera, Braconidae, Rogadinae) in North America: Part 1. *Entomological News* 117(5): 465-484.
- Harris, R. A.** (1979): A glossary of surface sculpturing. – Occasional Papers in Entomology, Department of Food and Agriculture, California 28: 1-31.
- Fortier, J. C.** 2007a. Eight new species and a key to species of the *Aleiodes pilosus* species-group (= *Tetrasphaeropyx* Ashmead) (Hymenoptera, Braconidae, Rogadinae) in North America, Part 2. *Entomological News* 118(1): 11-30.
- Fortier, J. C.** 2007b. The *Aleiodes pilosus* group (= *Tetrasphaeropyx* Ashmead) species of Canada, including seven new species and a key (Hymenoptera: Braconidae, Rogadinae). *Transactions of the American Entomological Society* 133(1+2): 1-20.
- Fortier, J. C.** 2008. The first host association for *Aleiodes shawi* (Hymenoptera: Braconidae: Rogadinae). *Entomological News* 119(2): 214-216.
- Harris, R. A.** 1979. A glossary of surface sculpturing. Occasional Papers in Entomology, California Dept. of Food and Agriculture, California 28: 1-31.
- Sharkey, M. J. and R. A. Wharton.** 2007. Morphology and Terminology. pp. 19-37. *In*, R. A. Wharton, P. M. Marsh, and M. J. Sharkey (Editors). *Manual of New World Genera of the Family Braconidae* (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. 439 pp.
- Shaw, M. R. and T. Huddleston.** 1991. Classification and Biology of Braconid Wasps. Handbooks for the Identification of British Insects. Volume 7. Part II. 7: 1-126.
- Shaw, S. R.** 1995. Family Braconidae. pp. 431-463. *In*, P. Hanson and D. Gauld (Editors). *The Hymenoptera of Costa Rica*. Oxford University Press. 893 pp.
- Shaw, S. R.** 1997. Subfamily Rogadinae *s.s.* pp. 403-408. *In*, R. A. Wharton, P. M. Marsh, and M. J. Sharkey (Editors). *Manual of New World Genera of the Family Braconidae* (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. 439 pp.
- Wharton, R. A., P. M. Marsh, and M. J. Sharkey** (Editors). *Manual of New World Genera of the Family Braconidae* (Hymenoptera). Washington, D.C. Special Publication of the International Society of Hymenopterists, No. 1. 439 pp.